3D THERMO-HYGRO-MECHANICAL APPROACH FOR SIMULATION OF THE CRACKING BEHAVIOUR OF A RC SLAB UNDER THE COMBINED EFFECTS OF APPLIED LOADS AND RESTRAINED SHRINKAGE

Gomes, J.[1], Carvalho R.[2], Sousa, C.[3], Granja, J.[1], Faria, R.[3], Schlicke, D.[4], Azenha, M. [1]

1: ISISE, University of Minho, School of Engineering
e-mail: {b7813, granja, miguel.azenha}@civil.uminho.pt

2: University of Minho, School of Engineering
e-mail: rui12carvalho@gmail.com

3: CONSTRUCT, University of Porto, Faculty of Engineering
e-mail: {cfsousa, rfaria}@fe.up.pt

4: Graz University of Technology, Institute of Structural Concrete
e-mail: dirk.schlicke@tugraz.at

Keywords: Service life behaviour, thermo-hygro-mechanical modelling, restrained shrinkage

Abstract. *The design of reinforced concrete (RC) structures that meet safety, functionality and aesthetic requirements during their lifespan, without unforeseen maintenance costs, depends on adequate design practices that allow engineers to properly control and predict crack widths on concrete. Even though there is a wide body of design codes and recommendations providing methodologies for reinforcement design on elements subjected to applied loads or imposed deformations, they do not provide unambiguous rules for RC structures under the combined effect of these actions, which is a typical situation in RC slabs applied in buildings. This is motivated by the lack of knowledge about the complex interactions that take place between self-imposed deformations, viscoelasticity and the effect of applied loads. This work intends to contribute for deepening the knowledge on this subject by performing a 3D thermo-hygro-mechanical analysis on a highly restrained slab in service load conditions, in which the temperature and moisture fields of the slab are determined in order to take into account the non-uniform distribution of stresses (in space and time) due to hydration and drying shrinkage. This analysis shows that the real restraint forces applied to the slab are in fact just a mere fraction of the those that would be expected in a hypothetical tie subjected to total restraint due to the loss of rigidity caused by crack development induced by a combination of flexural and self-induced stresses.*

Acknowledgement. Funding provided by the Portuguese Foundation for Science and Technology (FCT) to the Research Project IntegraCrete (PTDC/ECM-EST/1056/2014 - POCI-01-0145-FEDER-016841) as well to the Research Units ISISE (POCI-01-0145-FEDER-007633) and CONSTRUCT (POCI-01-0145-FEDER-007457) is gratefully acknowledged.